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A magnetic recording medium comprising a non-magnetic substrate, an orientation-determining layer, a non-magnetic undercoat layer, a magnetic layer, and a protective layer, in order, wherein:

the non-magnetic undercoat layer has a bcc structure;

the orientation-determining layer causes the non-magnetic undercoat layer to have a predominant orientation plane of (200) and has a crystal structure in which columnar fine crystal grains are inclined in a radial direction;

the ratio of a coercive force in a circumferential direction of the magnetic layer (Hcc) to a coercive force in a radial direction of the magnetic layer (Hcr) is more than 1; and

the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permits antiferromagnetic bonding to be formed therebetween.

- 2. A magnetic recording medium according to claim 1, wherein the magnetic layer has a laminated ferrimagnetic structure in which the directions of the magnetic moments of adjacent magnetic films are opposite to each other.
- 3. A magnetic recording medium according to claim 1, wherein the magnetic layer has a structure including a plurality of magnetic films and an intermediate film provided therebetween.
- 4. A magnetic recording medium according to claim 1, wherein the magnetic layer has two or more laminated structures, each including a magnetic film and an intermediate film adjacent thereto.
- 5. A magnetic recording medium according to claim 1, wherein, among the plurality of magnetic films, a magnetic film adjacent to a primary magnetic film having the largest coercive force has an antiferromagnetic bonding magnetic field larger than the coercive force of the magnetic film adjacent to the primary magnetic film.

6. A magnetic recording medium according to claim 2, wherein the intermediate film comprises a material predominantly containing at least one element selected from the group consisting of Ru, Cr, Ir, Rh, Mo, Cu, Co, Re, and

A magnetic recording medium according to claim 1, wherein the orientation-determining layer comprises one or more elements selected from the group consisting of Cr, V, Nb, Mo, W, and Ta.

- 8. A magnetic recording medium according to claim 1, wherein the orientation-determining layer comprises an alloy predominantly containing Cr.
- 9. A magnetic recording medium according to claim 1, wherein the orientation-determining layer predominantly comprises a Ta-containing alloy  $X_1$ Ta, wherein  $X_1$  is one or more elements selected from the group consisting of Be, Co, Cr, Fe, Nb, Ni, V, Zn, and Zr, and has a Fd3m structure or an amorphous structure.
- 10. A magnetic recording medium-according to claim 1, wherein the orientation-determining layer predominantly comprises an Nb-containing alloy  $X_2Nb$ , wherein  $X_2$  is one or more elements selected from the group consisting of Be, Co, Cr, Fe, Ni, Ta, V, Zn, and Zr, and has a Fd3m structure or an amorphous structure.
- 11. A magnetic recording medium according to claim 1, wherein the orientation-determining layer predominantly comprises CoTa, wherein the Ta content is 30-75 at% or CoNb wherein the Nb content is 30-75 at%, and has a Fd3m structure or an amorphous structure.
- 12. A magnetic recording medium according to claim 1, wherein the orientation-determining layer predominantly comprises CrTa wherein the Ta content 15-75 at% or CrNb wherein the Nb content 15-75 at%.
  - 13. A magnetic recording medium according to claim 1, wherein the

orientation-determining layer predominantly comprises NiTa wherein the Ta content is 30-75 at% or NiNb wherein the Nb content is 30-75 at%, and has a Fd3m structure or an amorphous structure.

- 14. A magnetic recording medium according to claim 1, wherein the orientation-determining layer comprises a non-magnetic metal having a Fd3m structure.
- 15. A magnetic recording medium according to claim 1 or 2, wherein the orientation-determining layer comprises a non-magnetic metal having a C15 structure.
- 16. A magnetic recording medium according to claim 1, wherein an orientation-enhancing layer is formed between the non-magnetic substrate and the orientation-determining layer.
- 17. A magnetic recording medium according to claim 16, wherein the orientation-enhancing layer comprises a material having a B2 structure or an amorphous structure.
- 18. A magnetic recording medium according to claim 16, wherein the orientation-enhancing layer predominantly comprises any one selected from the group consisting of NiAl, FeAl, CoAl, CoZr, CoCrZr, and CoCrC.
- 19. A magnetic recording medium according to claim 1, wherein a plurality of orientation-determining layers are provided.
- 20. A magnetic recording medium comprising a non-magnetic substrate, an orientation-determining layer for arranging the crystal orientation of a layer provided directly thereon, a magnetic layer, and a protective layer, in order, wherein:

the orientation-determining layer has a crystal structure in which columnar fine crystal grains are inclined in a radial direction;

the ratio of a coercive force in a circumferential direction of the magnetic

layer (Hcc) to a coercive force in a radial direction of the magnetic layer (Hcr) is more than 1; and

the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permits antiferromagnetic bonding to be formed therebetween.

A magnetic recording medium comprising a non-magnetic substrate, an orientation-determining layer for arranging the crystal orientation of a layer provided directly thereon, a non-magnetic undercoat layer, a magnetic layer, and a protective layer, the layers being formed on the substrate, wherein:

the non-magnetic undercoat layer has a bcc structure;

the orientation-determining layer is formed from an NiP alloy having an amorphous structure, and causes the non-magnetic undercoat layer to have a predominant orientation plane of (200);

the ratio of a coercive force in a circumferential direction of the magnetic layer (Hcc) to a coercive force in a radial direction of the magnetic layer (Hcr) is more than 1; and

the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permits antiferromagnetic bonding to be formed therebetween.

- 22. A magnetic recording medium according to claim 1, wherein the orientation-determining layer comprises nitrogen or oxygen in an amount of at least 1 at%.
- 23. A magnetic recording medium according to claim 20, wherein the orientation-determining layer comprises nitrogen or oxygen in an amount of at least 1 at%.
- 24. A magnetic recording medium according to claim 21, wherein the orientation-determining layer comprises nitrogen or oxygen in an amount of at least 1 at%.
  - 25. A process for producing a magnetic recording medium comprising a

non-magnetic substrate, an orientation-determining layer for causing the non-magnetic undercoat layer to have a predominant orientation plane of (200), a non-magnetic undercoat layer, a magnetic layer, and a protective layer, in order, wherein the non-magnetic undercoat layer has a bcc structure; and the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permits antiferromagnetic bonding to be formed therebetween, which process comprises:

releasing from a release source film formation particles containing a material constituting the orientation-determining layer to form the layer, and then

depositing the particles onto a deposition surface, wherein a direction of a trajectory of the film formation particles is controlled such that a projection line of the trajectory of the particles formed on the deposition surface lies substantially along a radial direction of a non-magnetic substrate, and such that an incident angle of the trajectory of the particles is 10-75° with respect to the non-magnetic substrate.

- '26. A process for producing a magnetic recording medium according to claim 25, further comprising subjecting the orientation-determining layer to oxidation or nitridation.
- 27. A process for producing a magnetic recording medium according to claim 25, wherein the orientation-determining layer is formed by sputtering using a sputtering target as a release source of film formation particles.
- 28. A process for producing a magnetic recording medium according to claim 27, further comprising subjecting the orientation-determining layer to oxidation or nitridation using a sputtering gas containing oxygen or nitrogen while forming the orientation-determining layer.
- 29. A process for producing a magnetic recording medium according to claim 26, wherein oxidation or nitridation is carried out by bringing the surface of the orientation-determining layer into contact with an oxygen-containing gas or a nitrogen-containing gas.

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30. An apparatus for producing a magnetic recording medium comprising a non-magnetic substrate, an orientation-determining layer for causing the non-magnetic undercoat layer to have a predominant orientation plane of (200), a non-magnetic undercoat layer, a magnetic layer, and a protective layer, in order, wherein the non-magnetic undercoat layer has a bcc structure; and the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permtis antiferromagnetic bonding to be formed therebetween, which apparatus comprises:

a release source for releasing film formation particles containing a material constituting the orientation-determining layer; and means for controlling a direction of a trajectory of the film formation particles released from the release source, wherein:

the direction-controlling means controls the direction of the trajectory of the particles such that a projection line of the trajectory of the particles formed on a deposition surface lies substantially along a radial direction of the non-magnetic substrate, and such that an incident angle of the trajectory of the particles is 10-75° with respect to the non-magnetic substrate.

Magnetic recording and reproducing apparatus comprising a magnetic recording medium, and a magnetic head for recording data onto the medium and reproducing the data therefrom, wherein:

the magnetic recording medium comprises a non-magnetic substrate, an orientation-determining layer for causing the non-magnetic undercoat layer to have a predominant orientation plane of (200), a non-magnetic undercoat layer, a magnetic layer, and a protective layer, in order, wherein the non-magnetic undercoat layer has a bcc structure; the orientation-determining layer has a crystal structure in which columnar fine crystal grains are inclined in a radial direction; the ratio of a coercive force in a circumferential direction of the magnetic layer (Hcc) to a coercive force in a radial direction of the magnetic layer (Hcr); is more than 1; and the magnetic layer includes a plurality of magnetic films having an hcp structure and a predominant orientation plane of (110), and permits antiferromagnetic bonding to be formed therebetween.